# JAPANESE AND OTHER OPHIUROIDS FROM THE COLLECTIONS OF THE MÜNICH MUSEUM


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# JAPANESE AND OTHER OPHIUROIDS FROM THE COLLECTIONS OF THE MÜNICH MUSEUM

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AILSA M. CLARK

THIS paper deals with some ophiuroids from the collections of the Zoologische Staatssammlung des Bayerischen Staates in Münich entrusted to me by Dr. H. Fechter, to whom I am deeply indebted, not only for the opportunity of studying such interesting material but also for permission to retain a proportion of the duplicate specimens for the British Museum collections.

Most of the material came from southern Japan (collected by Döderlein, Doflein and Haberer) or from the colder waters of the northern Japan Sea (Schmidt, Brashnikow and Domaschnew) but a number of other localities, ranging from the Mediterranean and West Indies to the Indian Ocean and western as well as eastern Pacific, are involved, including some specimens from the " Albatross " collections originating with the United States National Museum—the greater part of which has already been worked up by Koehler, Döderlein and others. Unfortunately some of the specimens were labelled only with collectors numbers or dates and in the case of the Japan Sea collections the details were often given only in almost illegible cyrillic script so that, in some instances, only an approximate transliterated version can be given where the name is untraceable in the atlases available. I am indebted to Mrs. H. Sabo for help in deciphering the labels.

The most interesting family represented is the Amphiuridae, which has been the subject of a recent revision by Fell (1962), involving extensive dismemberment of the major genera *Amphiura*, *Amphiodia*, *Amphipholis* and *Amphioplus*. I am not convinced that the resultant groups form natural genera and accordingly am retaining the customary combinations of names in this paper.

A number of the species represented evoke no special comment ; accordingly the records of these are simply listed at the end of the paper.

## Family **OPHIOMYXIDAE**

### ***Ophiobyrsa intorta*** (Koehler)

*Ophiobyrsella intorta* Koehler, 1922, 27–29, pl. iv, figs. 2–5, pl. xcii, fig. 4.

MATERIAL. " Albatross " station 5215, 12° 31′ 30″ N., 123° 35′ 24″ E. (Philippines), 1,105 metres, 3 specimens ; station 5219, 13° 21′ 00″ N., 122° 18′ 45″ E., 970 metres, 2 specimens.

The type of *Ophiobyrsella intorta* was also taken in the Philippines by the " Albatross ". The present specimens agree with Koehler's photographs and description of the type except that there is no row of median teeth up the apex of each jaw but simply multi-serial thorny-tipped tooth papillae throughout. The papillae altogether number about 20 on each jaw, including one or two almost superficial papillae lateral to the apex which might be termed oral papillae. The apical papillae deeper in the mouth are longer than the superficial ones. Koehler notes " Together with the tooth papillae the mouth (oral) papillae form a little bundle of short, slender and spinulose spines continuous with the teeth which are fairly regular in their arrangement *and which have exactly the same form as these papillae.*" [My italics]. If the " teeth " are as narrow and spiniform as the papillae in the type it would be surprising if they formed only a single vertical row not flanked by other papillae. In view of the otherwise close correspondence between Koehler's description and figures and the present specimens, I think the only difference is one of terminology and accordingly am referring *intorta* to the genus *Ophiobyrsa*, characterized by the presence of few oral papillae, many tooth papillae and no proper teeth.

It should be noted that the type species of *Ophiobyrsa* is *O. rudis* Lyman, not *O. hystricis* Lyman as stated by Koehler.

In comparison with the holotype of *O. rudis* the present specimens differ notably in the much smaller oral shields with the adorals meeting proximal to them, the fewer and smaller disc platelets and spinelets and the absence of spinelets on the fragmented dorsal arm plates. *Ophiobyrsa synaptacantha* H. L. Clark, from south-west Japan differs in the separated adorals though it has similarly fragmented and spineless dorsal arm plates.

### ***Ophiobyrsa acanthinobrachia*** H. L. Clark

*Ophiobyrsa acanthinobrachia* H. L. Clark, 1911, 269–270, fig. 134 ; Matsumoto, 1917, 24.

MATERIAL. Doflein, no. 588, Yogashima, 150 metres, 31.x.1904, 1 specimen.

Murakami (1944) has described a species *Ophiobyrsa strictima*, from unknown locality, in his paper on the ophiuroids of Ogasawara and Yaeyama, the unique type having the disc diameter 23 mm. He notes that it is closely related to *O. acanthinobrachia*, which it resembles in having spinelets on the dorsal arm plates. The differences between them given by Murakami are that *strictima* has oval rather than rounded-triangular oral shields, narrower adoral shields, more compact disc scaling and the tooth papillae arranged in three rather than two vertical rows.

The type of *O. acanthinobrachia* is also large with the disc diameter 20 mm., whereas in the present specimen it is only 7 mm., the arms being about 45 mm. long, giving a ratio of 1 : 6·4 compared with 1 : 14 in the type of *O. acanthinobrachia*. The disc scales are slightly spaced and the tooth papillae are arranged in two vertical rows so I am referring the specimen to H. L. Clark's species. Besides the tooth papillae, which number about six in each vertical row with the longest ones highest in the oral slit, there is an irregular cluster of smaller papillae at the superficial end of the two rows as well as one slightly larger papilla lateral to the apex of the jaw each side,

which might be termed an oral rather than a tooth papilla. On the distal side of the superficial second oral tentacle there is an erect papilla or scale not mentioned by H. L. Clark, though his figure shows an oral papilla just proximal to the tentacle pore. The arm spines number up to five, as might be expected at this size, the type having seven proximally.

## Family **OPHIACANTHIDAE**

### *Ophiacantha acanthinotata* H. L. Clark

*Ophiacantha acanthinotata* H. L. Clark, 1911, 203–204, fig. 94 ; Matsumoto, 1917, 117 ; Murakami, 1942, 3.

MATERIAL. Döderlein, Enoshima 22, 1 specimen.

The disc diameter is 6 mm. and the basal arm segments have not more than nine arm spines each side in comparison with the type, in which there were ten or eleven spines proximally at a disc diameter of 9 mm. The two more distal oral papillae in each series of three are both rather paddle-shaped, the third one not the widest, unlike that of the type. Another slight difference is that a wedge-shaped area at the distal end of each radial shield is left bare.

### *Ophiacantha rhachophora* H. L. Clark

*Ophiacantha rhachophora* H. L. Clark, 1911, 201–202, fig. 92 ; Matsumoto, 1917, 119–120, fig. 30 ; Murakami, 1942, 5–6 ; Djakonov, 1954, 41–42, fig. 10.

MATERIAL. Döderlein : Enoshima 22, 1 specimen ; Enoshima 25, 14 specimens ; Yogashima, 7 specimens ; Yogashima, 2.xi.1881, 1 specimen ; 7.xi.1881. III, 250 fathoms (457 metres), 2 specimens ; 2.xi.1881. III, 1 specimen ; no details, 2 specimens.

The number of oral papillae is variable in these specimens. As Matsumoto has shown, the distalmost and thorniest one arises vertically from the adoral shield. One or two of the other papillae are bifurcate dorso-ventrally at the tip but none are really thorny. In one specimen with disc diameter 5 mm. there are only three oral papillae each side of the apical one, including the clavate, thorny, adoral shield papilla, but usually the number is five, though six may be found in some series as on one side of the jaw figured by Matsumoto. The oral shields usually have a more prolonged and acute proximal angle than is shown in H. L. Clark's figure of the type.

The thorny tentacle scales and distalmost oral papilla as well as arm spines make this species easily recognizable from the sympatric *Ophiacantha pentagona*.

### *Ophialcaea congesta* (Koehler)

*Ophiacantha congesta* Koehler, 1904, 103–104, pl. xxiv, figs. 1, 2.
*Ophialcaea congesta :* H. L. Clark, 1915, 217.
*Ophialcoea congesta :* Koehler, 1922, 85, pl. xv, figs. 6, 7.

MATERIAL. " Albatross " station 5119, 13° 45′ N., 120° 30½′ E. (Philippines), 721 metres, 1 specimen ; station 5618, 0° 37′ N., 127° 15′ E. (Moluccas), 763 metres, 1 specimen.

As Koehler (1922) noted, only the basal dorsal arm spines are enlarged. In the case of the specimen from " Albatross " station 5618 this applies to the uppermost spines of the first three free segments ; on the second and third segments these spines measure 1·9 mm. in length, whereas on the fourth segment tqe corresponding spine of each side is only 1·3 mm. long. The length of the basal segments is about 1·0 mm. These enlarged spines also differ in being distinctly clavate in shape. The disc diameter is *c.* 9·5 mm. but the disc is rather distorted. The arm length is *c.* 50 mm. There are four arm spines basally but the number increases to five beyond the thirteenth segment or thereabouts. The dorsal arm plates of at least the proximal half of the arm each have a row of minute thorns along the distal edge. Neither of these last two features was observed by Koehler in his material. This specimen also differs from his description in the apical oral papilla (or lowest tooth), which is much wider than the lateral papillae, not similar to them. The disc granules are conical (or at least appear so through the thin skin). The dorsal arm plates have the distal edge convex, unlike those of the type, which Koehler described as having parallel sides, but much like the specimen he figured in 1922.

Because of the thorns on the dorsal arm plates, this species runs down to *Ophiogema* in Fell's generic key (1960) but differs markedly from the type species, *Ophiogema punctata* Koehler, 1922, in having a coat of conical granules (or they could be called very short spinules) on the disc rather than " a rather stout pointed spine " on each disc plate ; the ventral arm plates are also different, the dorsal arm plates have thorns rather than spinelets and in *Ophiogema punctata* the arm spines are more needle-like and numerous, seven in number, none of them are clavate and they are " finely echinulated " not smooth. With so many differences I have no doubt that the two species are generically distinct. The rib-like concealed radial shields give *Ophialcaea congesta* the appearance of a Euryalid rather than an Ophiacanthid.

The specimen from " Albatross " station 5119 is similar in size but only the first two free arm segments, especially the second, have the uppermost spine enlarged. The thorns on the dorsal arm plates are also less distinct.

## Family **OPHIACTIDAE**

### ***Ophiactis macrolepidota*** Marktanner-Turneretscher

*Ophiactis macrolepidota* Marktanner-Turneretscher, 1887, 298, pl. xii, figs. 12, 13 ; Döderlein, 1898, 484, pl. xxxvii, fig. 1 ; Matsumoto, 1917, 155–156, fig. 37 ; Murakami, 1942, 8 ; 1943, 167.

Material. Döderlein : Yogashima, 2 specimens ; Kashiyama, 1 specimen.

Whereas the largest specimen of *Ophiactis pteropoma* in the present collection has only three arm spines though the disc diameter is 4 mm., all three of these specimens, which are smaller, have four spines on the second free arm segment, though the following segments have only three ; also the second from lowest spine differs in being somewhat squared at the tip.

I agree with Matsumoto and Murakami that such Japanese specimens are almost certainly conspecific with Döderlein's from Amboina but there is some doubt whether

this is also true of the holotype of *O. macrolepidota*. Not only was it supposed to come from " Sidney " (presumably Sydney, N.S.W.), a temperate locality (though a few tropical species do have their southern limit there) and one from which there are no later records, but also it was described as having the ventral side of the disc (rather improbably for an *Ophiactis*) covered with skin only. If Marktanner's description was wrong in this respect it is possible that his species is now known by another name, there being several nominal species of *Ophiactis* found in that part of Australia.

## Family **AMPHIURIDAE**

### ***Amphiura iridoides*** Matsumoto

*Amphiura iridoides* Matsumoto, 1917, 205–207, fig. 56.
*Monamphiura iridoides* : Fell, 1962, 11.

MATERIAL. Döderlein : nr. Yogashima, 1 specimen ; Yogashima, 200 metres, 1 specimen ; Enoshima 22 and 24, 5 specimens ; no details, 1 specimen.

One of the two from Yogashima particularly approaches *Amphiura iris* Lyman in having the distal oral papilla thicker than is usual in *iridoides*, while on some jaws the papilla appears to have a double apex, being preserved in the erect position, since its thin cross-section is slightly bowed ; when appressed the papillae appear leaf-shaped. There are six arm spines on one or two basal segments although the disc diameter is only about 3·5 mm., whereas Matsumoto's holotype of *A. iridoides* with disc diameter 4 mm. has only five arm spines. The type of *Amphiura iris* at a disc diameter of 5 mm. has only four spines although Matsumoto's largest specimen of *iris*, with diameter 5·5 mm., did have five spines. The Yogashima specimen also differs from *A. iris* in having the disc scaling very smooth and the dorsal arm plates not " humped ", agreeing in these characters with *A. iridoides*. The radial shields are nearly three times as long as broad and distinctly divergent, whereas in the type specimen of *A. iris* they are relatively larger and are parallel in alignment.

### ***Amphiura iris*** Lyman

(Text-fig. 1)

*Amphiura iris* Lyman, 1879, 23, pl. xi, figs. 302–304 ; 1882, 132, pl. xvi, figs. 4–6 ; Matsumoto, 1917, 204–205.
*Monamphiura iris* : Fell, 1962, 11.

MATERIAL. Enoshima, 230 fathoms (420 metres), 1 specimen.

The disc diameter is 5 mm. and the arm length 40 mm., a ratio of 1 : 8, whereas Matsumoto's specimen measured 5·5/25 mm. or 1 : 4·5. Unfortunately the holotype has all the arms badly broken and no estimate of their length can be made. The Enoshima specimen has the two infradental oral papillae of each jaw spaced from one another with a third papilla or tooth at the same level between them ; on one jaw, however, the infradental papillae are placed asymmetrically. In the holotype

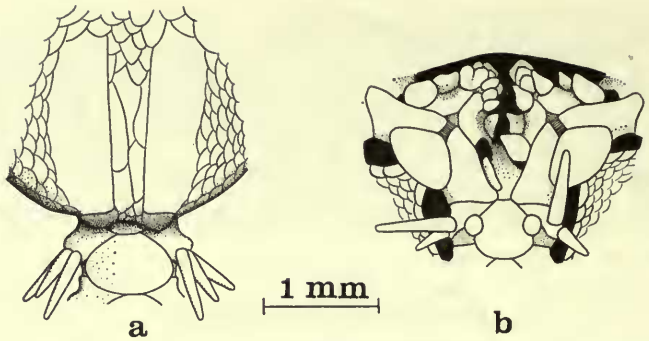


FIG. 1. *Amphiura iris* Lyman. Holotype, B.M. no. 82.12.23.104. (a) Dorsal and (b) ventral views of parts of the disc and oral area. In (a) the scales between the radial shields are very indistinct and some imagination has been used in showing their limits ; nevertheless, they are certainly more numerous than shown in Lyman's figure, where only one row is drawn. In (b) one of the four distal oral papillae included is displaced and seen edge-on.

of *A. iris* the infradental papillae are closer together on three jaws, the small lowest tooth being just above and partially between them ; a fourth jaw is damaged but the fifth has a cluster of terminal papillae almost like an *Ophiopsila*, though these too are damaged. In other respects the Enoshima specimen agrees with the type, that is in the disc scaling, long parallel radial shields, shapes of the arm plates (the dorsal ones slightly humped), the form of the distal oral papilla and the large single tentacle scale.

### *Amphiura trachydisca* H. L. Clark

*Amphiura trachydisca* H. L. Clark, 1911, 149–150, fig. 60 ; Matsumoto, 1917, 201 ; Murakami, 1942, 19.

MATERIAL. Enoshima, 230 fathoms (420 metres), 1 specimen.

H. L. Clark's figure is rather misleading since the disc scales of this species do not so much bear tubercles as have their free edges thickened and erected. This is true not only of this specimen but also of the type, which I have examined in the U.S. National Museum.

### *Amphiura arcystata* H. L. Clark

*Amphiura acrystata* (lapsus for *arcystata*) H. L. Clark, 1911, 145–148, fig. 58 ; Matsumoto, 1917, 203 ; Murakami, 1942, 11.
*Amphiura arcystata* H. L. Clark, 1915, 224 ; Djakonov, 1954, 74.
*Hemilepis arcystata* : Fell, 1962, 10.

MATERIAL. Döderlein, no details, 1 specimen.

In this specimen the disc is almost completely scaled above, though interradially the scales are obscured ; the ventral side is quite bare. Beyond the base of the arm the middle spines become square at the tips and even slightly bihamulate but the tip is never very broad and the general impression given by most of the spines is that they

are tapering. The dorsal arm plates are ovate, as in the holotype, not rhombic as in the two other specimens figured by H. L. Clark.

Fell (1962) referred *Amphiura arcystata* to *Hemilepis*, which he characterized as having the disc scaled above but partly or wholly naked below. This move was evidently a compromise measure between the three specimens figured by H. L. Clark (1911, fig. 58, p. 146) under the name of *arcystata*, two of which (including the holotype) have more or less extensive skin on the dorsal side interradially and centrally, though the ventral side is quite naked, while the third specimen has a complete scale-covering on both sides of the disc. In fact the type of *arcystata* conforms more closely to the diagnosis of Fell's *Amphinephthys*, with type species *Amphiura crossota* Murakami from the Caroline Islands, which similarly has scales only around the radial shields. Matsumoto (1917) recorded some additional Japanese specimens as *arcystata*, noting that the larger ones have discs of the " *Ophionephthys*-type " (i.e. with scales only around the radial shields), implying that the smaller ones have more extensive scaling, as with H. L. Clark's " Albatross " specimens. Djakonov (1954) also found that some small specimens from the north-west Pacific have fine granuliform scaling on both sides of the disc in contrast to the more usual nearly naked condition.

Unless the station number was incorrect (as H. L. Clark suggested might be possible), the holotype of *arcystata*, together with the 25 " topotypes " from the same station, was from Californian waters, though, with a single exception of doubtful identity, all the other " Albatross " specimens were from Japan. However, in support of the correctness of the " Albatross " station given for the type there are further records from the eastern Pacific, notably by May, Nielsen and Ziesenhenne. Although all the specimens of the two latter authors appear to have had mainly naked discs, May noted that specimens from Monterey Bay usually show this condition but sometimes have the disc completely scaled above.

If H. L. Clark, Matsumoto, Djakanov and May are right in considering specimens with more fully scaled discs as conspecific with others with reduced scaling, it seems to me inadvisable to set up generic distinctions based on the extent of the disc scaling alone, as Fell has done. Though very useful in reducing the large number of species of *Amphiura* to more manageable groups, the resultant subdivision is I think too artificial for these groups to be acceptable as genera (or even subgenera) without further limitation of characters. The second character used by Fell to delimit his new genera, namely the number of tentacle scales, is also of doubtful value at the generic level, in my view, but I hope to be able to examine this problem in the detail which it deserves before too long.

### *Amphiura* sp. cf. *euopla* H. L. Clark

see *Amphiura euopla* H. L. Clark, 1911, 144–145, fig. 57 ; Matsumoto, 1917, 201–202, fig. 55 ; Murakami, 1944, 265–266.
*Hemilepis euopla* : Fell, 1962, 10.

MATERIAL. Döderlein, Kagoshima, 1 specimen.

This specimen has the disc diameter 5 mm. and differs from H. L. Clark's descrip-

tion of the type of *euopla* (d.d. 10 mm.) in having the disc finely scaled ventrally as well as dorsally, the radial shields just contiguous, the primary plates distinct, the oral shields with no distal lobes, the distal oral papilla more pointed and the second and third of the seven arm spines conspicuously bihamulate. However, Matsumoto and Murakami both refer specimens to *euopla* with disc diameter less than 6 mm. having the discs scaled ventrally, the primaries distinct, shorter oral shields and the middle arm spines not just blunt but thorny-tipped (some appearing almost hatchet-shaped in Matsumoto's figure while he uses the term " spur-shaped " to describe them). The difference in the radial shields may be illusory since I found on examination of the holotype that the scales only extend between the two radial shields of each pair for the proximal two-thirds of their length, beyond which they gape apart from each other, probably unnaturally. The artist has used his imagination in drawing scales between the distal ends of the shields, which I believe were originally contiguous as they are in this specimen. Even so, there are still so many differences between the type and this specimen, together with Matsumoto's smaller ones, that I am not convinced that they are conspecific. In addition to the characters already mentioned, H. L. Clark notes that a young specimen of *euopla* with disc diameter less than 4 mm. has only four or five arm spines, whereas this one at diameter 5 mm. has as many as seven spines.

In running down this specimen in Matsumoto's key to the Japanese species of *Amphiura* I found the key rather misleading. Both *A. euopla* and *arcystata* come within the section with two tentacle scales, a single distal oral papilla and five to seven arm spines, the last distinction being coupled with the nakedness of the disc at least ventrally, despite the fact that H. L. Clark has referred fully scaled specimens to *arcystata* and Matsumoto himself proceeds to do the same for *euopla*. Then the two species are supposedly distinguished from each other by four characters, according to Matsumoto. However, the first of these four is the thickness of the disc, said to be thick in *euopla* and thin in *arcystata*, and I think that the thickness is too liable to be influenced by abundance of food, seasonal conditions and preservation to allow its use as a specific character. The second point is the extent of the scaling on the disc ; this is given as less extensive in *arcystata* but, in view of the variation in this character observed by both H. L. Clark and Matsumoto, this does not seem to provide a valid distinction. Thirdly, there is the shape of the radial shields, described as " short " in *euopla* but " long and rather narrow " in *arcystata* ; although the type of *euopla* does have fairly short shields, in the larger, and to a lesser extent also the smaller, specimen figured by Matsumoto under the name of *euopla*, I would describe the shields as long and narrow (if the proportions shown are true). Also in the third specimen figured by H. L. Clark under the name of *arcystata* (the one with the disc fully scaled), the radial shields are much shorter than in the type and other specimen figured. Finally the shape of the arm spines is given as " spur-shaped and rough at the tip " in *euopla* as opposed to " conical, not rough " in *arcystata* ; this may be a genuine difference but it should be pointed out that the single specimen in the present collection referred by me to *arcystata* does have the tips of the middle arm spines beyond the base of the arms slightly squared-off and there may even be a small thorn proximally and

distally, though this is quite inconspicuous in comparison with the much widened bihamulate tip of the second and third spines in the specimen from Kagoshima which I believe is conspecific with the smaller ones Matsumoto referred to *A. euopla*, if not with the type of *euopla*.

Another Japanese species with which the Kagoshima specimen has some affinity is *A. pachybactra* Murakami, 1942, from the Izu Peninsula. The latter similarly has the disc completely scaled, two tentacle scales and seven arm spines (at a disc diameter of 8 mm.) but the primary plates are not distinct (though this may well be expected at such a relatively large size), *all* the arm spines are square-tipped and the second to fifth of them are thorny-tipped without being distinctly bihamulate, the distal oral papilla is blunter (in this specimen it is spiniform), the dorsal arm plates are narrower and the oral shields have a flat distal side, their shape being broadly pentagonal. In fact, *A. pachybactra* is very similar to *A. ambigua* Koehler, 1905, of which a large specimen with disc diameter 11 mm. from Indo-China (identified by Mortensen) is in the British Museum collections. I have compared this specimen with the one from Kagoshima and find that it too has the middle arm spines modified with bihamulate tips, but these tips are much smaller, barely squared-off on the second and third spines and thus more like the corresponding spines in the specimen from the Münich collection which I have referred to *arcystata*. However, *A. ambigua* also has the disc fully scaled, two tentacle scales and divergent radial shields just contiguous distally, though it differs in having long distal lobes on the oral shields and the distal oral papilla shorter and blunter. In the specimen of *A. ambigua* figured by Koehler in 1922 (pl. 69, figs. 5 and 6) the oral shields appear to have a rather shorter distal lobe but it is still not as short as the lobe in this specimen, where the length : breadth ratio of the whole shield is 14·5 : 14 and the distal side has only a very obtuse angle.

Murakami compared *A. pachybactra* instead with *A. rapida* Koehler, 1930, which is a synonym of *A. poecila* H. L. Clark, 1915, according to H. L. Clark in 1946, the types of both originating in the waters of southern Australia. *A. poecila* has similar oral shields, distal oral papillae, tentacle scales, fully-scaled disc with primaries distinct and fan-shaped dorsal arm plates proximally, like the Kagoshima specimen but it differs in having the radial shields quite separate.

It is suprising that Murakami (1944) referred specimens with the disc fully-scaled to *A. euopla* rather than to his *A. pachybactra* without commenting on their inevitable resemblance to the latter.

### ***Amphiura*** sp. juv. aff. ***koreae*** Duncan

see *Amphiura koreae* Duncan, 1879, 466, pl. x, figs. 18, 19 ; Matsumoto, 1917, 198–199, fig. 53.

MATERIAL. Döderlein, Kagoshima, 2 specimens.

Even the larger specimen has the disc diameter only 2·6 mm. It has two short distal oral papillae like *A. koreae* but differs from Duncan's type specimen in having the proximal end of the oral tentacle scale more nearly superficial and the two papillae of each infradental pair often spaced from each other with a conical tooth in between. Also the type of *koreae* has the inner distal oral papilla arising from the side of the

oral plate rather than from the adoral shield as it does here. However, Lütken and Mortensen (1899) and Matsumoto (1917) emphasize that the oral structure is very variable in the types of *A. diomediae*, which is generally considered to be a synonym of *koreae*.

I believe that *Amphilepis diastata* Murakami, 1942, may prove to be another synonym of *Amphiura koreae*. Although Murakami describes it as having only two oral papillae (i.e. one infradental and one distal) his figure shows two distal papillae, the inner one arising from the distal end of the oral plate where it joins the adoral shield.

The Kagoshima specimen also has some resemblance to *Amphiura confinis* Koehler, 1904, from the East Indies, especially in the superficial position of the oral tentacle scale. The same character allies it with the specimens named *Amphiura concolor* by Lyman from " Challenger " station 191 in the Aru Islands, which also have two distal oral papillae on the adoral shield and the infradental papillae often spaced, conical and with a cusped tooth between them. The " Challenger " specimens are much bigger, even the smallest of them having the disc diameter 6 mm. and their consecutive dorsal arm plates are quite separate from each other, also the radial shields are not contiguous at all distally; otherwise they are very like this specimen. I do not believe that they are conspecific with the type specimen of *A. concolor*, described by Lyman also in the " Challenger " report, since the type has rounded, closely-placed infradental papillae, the dorsal arm plates just contiguous, the disc scales thicker, the oral and adoral shields of different shapes and more numerous arm spines. Indeed, I believe that the Aru Island specimens should be referred to *A. confinis*, though they differ slightly in having the disc scales thinner and the disc as a result smoother than in the types of *confinis*.

### ***Amphiura inepta*** Djakonov

*Amphiura inepta* Djakanov, 1954, 77–79, fig. 23.
*Amphiura carchara* : Djakonov, 1954, 80–81, fig. 25. [Non *A. carchara* H. L. Clark, 1911.]
*Monamphiura inepta* : Fell, 1962, 11.

MATERIAL. Brashnikow, no, 18, June, 1899, (northern Japan Sea) 2 specimens.

The larger specimen has the disc diameter 6 mm. and there are four spines on each side for the first 17 free arm segments on the only arm remaining attached. The smaller specimen has the disc diameter *c.* 4·5 mm. and has four spines on about 12 proximal segments. The discs of both have the ventral scales spaced from each other in transparent skin, some enlarged plates dorsally and centrally but not forming a regular rosette, the oral shields very blunt proximally, the adorals barely or not quite meeting and the dorsal arm plates oval or wide fan-shaped with a very obtuse proximal angle.

The type specimen of *A. inepta* has the disc diameter 14 mm., while in the type of *A. carchara* H. L. Clark it is 8 mm. Even at this relatively large size the latter has no more than three arm spines, also its primary rosette is not mentioned by H. L. Clark and so is probably indistinct, the disc skin is completely lacking in scales on the ventral side, the adorals are separate interradially and the orals have a proximal

angle. The specimen from the northern Okhotsk Sea figured by Djakonov under the name of *A. carchara* has the disc diameter 5·2 mm. but already has four arm spines proximally and also agrees with the present material in the shape of the oral and adoral shields and in the spaced scales of the ventral side of the disc. Djakonov himself recognized all these differences from the type of *A. carchara* but still did not compare the specimen with *A. inepta*. Although in his key he included *inepta* among the species with two tentacle scales proximally, rarely only one, the figure he gives of the species shows only one scale throughout; the two Brashnikow specimens similarly have no more than one scale. Djakonov's material of *A. inepta* came from La Perouse Strait (between Hokkaido and Sakhalin), southern Sakhalin and the north-east Okhotsk Sea.

### ***Amphiura digitula*** (H. L. Clark)

(Text-fig. 2)

*Amphiodia digitula* H. L. Clark, 1911, 162–164, fig. 70.
*Amphiura digitula*: Matsumoto, 1917, 199–200, fig. 54; Djakonov, 1954, 71.
*Amphiura leptopholida* H. L. Clark, 1915, 226–227, pl. iv, figs. 11, 12 [Possibly recognisable as a distinct form of *digitula*.]
*Diamphiodia digitula*: Fell, 1962, 14.

Material. Döderlein: Enoshima 22, 1 badly damaged specimen; Enoshima 24, 3 specimens without discs; (?Doflein), Kachiyama, 5 specimens with discs, 6 without; Döderlein: Enoshima, 4 specimens of forma *leptopholida*.

The present material together with Matsumoto's observations and my drawings of the types of some of H. L. Clark's nominal species from Japan, made in 1953 in the U.S., suggest that *Amphiura digitula* tends to intergrade with *Amphioplus ancistrotus* (H. L. Clark). This is not so surprising as it may seem at first sight since the two genera are closely related and species of *Amphiura* with two distal oral papillae, such as *A. digitula*, need only the development of a single intermediate papilla to bridge the gap to *Amphioplus*. The species of both genera possess a first oral tentacle scale higher in the oral slit each side of the jaw, which is completely absent in *Amphiodia*, where the oral papillae are only numerically, not morphologically, intermediate between those of the type species of *Amphioplus* with four papillae and of *Amphiura* with two.

H. L. Clark in 1911 referred both *digitula* and *ancistrotus* to *Amphiodia* but when Matsumoto studied the homologies of the oral papillae of Amphiurids he recognized that, although *digitula* has two distal oral papillae, these are based on the adoral shield rather than the oral plate and an oral tentacle scale (additional papilla in Matsumoto's terminology) is present; accordingly the species should be referred to *Amphiura*. There are several comparable species of *Amphiura*, notably *A. koreae*, in which there are two distal oral papillae, similarly arising from the edge of the adoral shield (though the inner of the two may be based about the point of junction of the adoral shield and the oral plate). Even if Fell's *Diamphiodia* proves to be sufficiently natural for recognition as a genus distinct from *Amphiodia*, there is no question that

*digitula* could be referred to it since the type species of *Diamphiodia* has oral papillae similar to *Amphiodia*. Matsumoto also referred *Amphiodia ancistrota* to *Amphioplus* because of its total of four (sometimes even five) oral papillae together with an oral tentacle scale.

Both these species have rather unusual paired digits outside the radial shields, which prompted the name *digitula* ; also both have two tentacle scales of moderate size, somewhat similar arm plates and radial shields which are divergent and more or less narrow (the width is exaggerated in H. L. Clark's figure 69 (1911) of *A. ancistrotus* in comparison with the type specimen). The type of *Amphiura digitula* is distinguished particularly by the spiniform shape of the inner one of the two distal oral papillae and by the diastema between this papilla and the infradental one (characteristic of the genus *Amphiura* as opposed to *Amphioplus*) also by the fine, almost granuliform, scaling of the disc ventrally and marginally, contrasting with the smoother and larger dorsal scales. In the type of *Amphioplus ancistrotus* there are four rounded oral papillae in continuous series and the ventral disc scales are smooth and not extremely fine.

Between or close to one or other of these two extremes come two other Japanese amphiurids described by H. L. Clark in 1915 as the types of new species. One of these was referred to *Amphiura* and the other to *Amphioplus* (incidentally supporting Matsumoto's generic dispositions), so that Dr. Clark failed to compare them with either *digitula* or *ancistrotus* since he had left these both in *Amphiodia* in 1911.

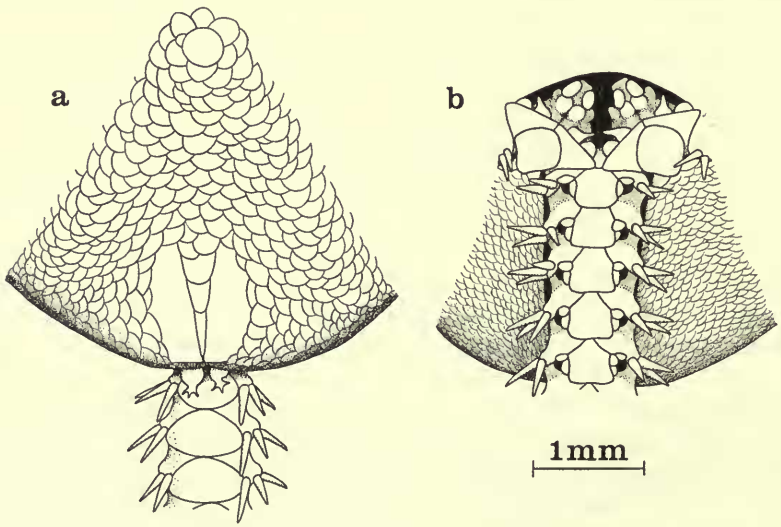


FIG. 2. *Amphiura digitula* forma *leptopholida* H. L. Clark. Holotype of *A. leptopholida*, M.C.Z. no. 1365. (a) Dorsal and (b) ventral partial views of disc and oral area.

The first of these nominal species (fig. 2), which he named *Amphiura leptopholida*, has oral papillae almost identical with those of the type of *digitula*, the inner of the two distal ones being spiniform ; also it has pairs of digits outside the radial shields. The

only differences are that the ventral disc scales are not very small and granuliform but smooth and somewhat larger and the second from lowest of the four arm spines has a very slight terminal hook rather than a simple tip. The four specimens in the Münich collection from " Enoshima " differ from the complete specimens labelled "Enoshima 22" or " 24" and the rest from Kachiyama (all of which are immediately recognizable as *digitula*) in having the ventral disc scales smooth, not granuliform, and the second arm spine distinctly hooked on the segments beyond the base of the arm. Since the disc is easily lost in this species, judging from the proportion of incomplete specimens in the present collection, it is possible that the difference in disc scaling at least is correlated with regeneration. Three of the four Enoshima specimens exceed by 2 or 3 mm. the 6 mm. disc diameter of the types of both *A. digitula* and *leptopholida*, so the presence of five rather than four arm spines basally is only to be expected ; the fourth specimen, disc diameter 5 mm., has four spines basally.

The differences being of such small magnitude, I believe that the types of *digitula* and *leptopholida* are conspecific, nevertheless I think it worthwhile to distinguish specimens with smooth disc scales and hooked arm spines (if these characters prove to be consistently linked) as forma *leptopholida*, though such infrasubspecific taxa have no status in taxonomy, according to the Code of the International Commission.

The second nominal species of H. L. Clark, 1915, is *Amphioplus lobatodes*. Apart from minor differences in the proportions of the oral shields and lesser curvature of the second arm spine, there seems to me no reason why it should not be referred to the synonymy of *A. ancistrotus*.

The Münich collection also includes three Amphiurids which, like *Amphiura leptopholida*, present an intermediate condition between *A. digitula* and *Amphioplus ancistrotus*. These are described under the heading of the latter species.

### *Amphioplus ancistrotus* (H. L. Clark)

(Text-figs. 3 and 4)

*Amphiodia ancistrota* H. L. Clark, 1911, 161–162, fig. 69.
*Amphioplus ancistrotus* : Matsumoto, 1917, 171–172, fig. 43 ; Chang, 1948, 54–55, fig. 11, pl. viii, fig. 7 ; Djakonov, 1949, 54, fig. 69 ; 1954, 61 ; Fell, 1962, 17.
*Amphioplus lobatodes* H. L. Clark, 1915, 254–255, pl. vii, figs. 12, 13.

Material. No details, presumably southern Japan, 2 specimens ; Haberer, Sagami Bay, 7.vii.1904, 1 specimen of a distinct form ; Döderlein, Enoshima 24, 2 specimens of the same form.

As mentioned under the heading of *Amphiura digitula*, I consider *Amphioplus lobatodes* to be a synonym of *A. ancistrotus*. The drawing of the type, which I made in 1954 when visiting the United States, shows no digits distal to the radial shields in the radius depicted. Unfortunately I omitted to notice whether this was also true of the other radii. H. L. Clark's brief description, largely comparative with *A. lobatus*, makes no mention of this feature. If digits are really absent, then it may be possible to distinguish *lobatodes* from *ancistrotus* but I doubt this.

In the two specimens with no detailed locality the oral papillae are all short and rounded. Although H. L. Clark's figure of the holotype shows the third (from innermost) papilla as conical and somewhat elongated, I found on examination of the holotype that the three inner papillae are all rounded, though subequal, while the third one is not erect (fig. 3*a*) ; in fact they are just as described by Dr. Clark, accordingly I have no doubt that these two specimens are conspecific with the type.

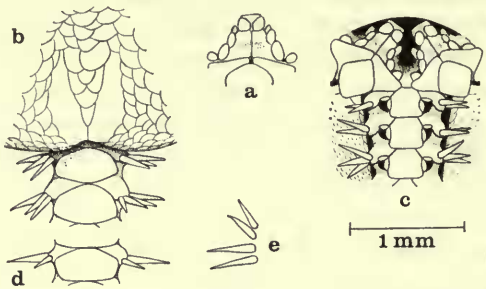


FIG. 3. *Amphioplus ancistrotus* (H. L. Clark). (a) Holotype of *Amphiodia ancistrota* H. L. Clark, U.S.N.M. no. 25601, oral papillae. (b) to (e) holotype of *Amphioplus lobatodes* H. L. Clark, M.C.Z. no. 1480 ; (b) dorsal and (c) ventral partial views of disc and oral areas, (d) segment with twenty-second dorsal arm plate, (e) arm spines of twelfth free segment. In (c) the ventral scaling is in reality barely distinct, especially proximally where it is very tenuous and broken in most interradii.

The other three specimens in the Münich collection, however, have the third oral papilla, and to some extent the second also, erect and spiniform. Matsumoto's figures 43*b* and *c* both show these papillae as elongated and acute, but in Chang's drawing all the papillae are short and rounded as in the type of *Amphioplus lobatodes* (fig. 3*b–e*). (It should be noted that Chang's specimen has the disc naked ventrally so the identification may be incorrect, however the disc diameter was only 3 mm. and the small size might contribute to this deficiency.) In most other characters, namely the form of the arm plates, tentacle scales, hooked second arm spine and particularly the paired digits outside the radial shields, these three specimens agree with the first two mentioned but their oral papillae provide such a sharp contrast that I consider it worthwhile to designate this form with the two middle oral papillae erect and spiniform as forma *anisopapilla* of *Amphiura ancistrotus*. Although such infrasubspecific names are not recognized by the International Commission on Zoological Nomenclature and have no status in taxonomy, I think they still have their uses for the sake of comparison. The shape of the oral shields, the extent of contact of the adorals and the proportions of the radial shields all appear to be variable in *A. ancistrotus* and it is interesting that some of the shapes exhibited approximate to those found in *Amphiura digitula*. (It may be noted here that H. L. Clark's figure of the holotype of *Amphioplus ancistrotus* shows the radial shields shorter than they really are and therefore relatively too wide.) There are two minor differences between the specimen of forma *anisopapilla* figured and the type of *ancistrotus*, namely in the former the disc scales are particularly indistinct and the dorsal arm plates appear thinner and

more transparent. However, I doubt whether these differences are significant.

The two specimens of unknown locality, which may be designated as forma *ancistrotus*, have disc diameters of 9 mm. and 6 mm. In both of them the second from lowest arm spine is hooked but the larger specimen has five arm spines on the first four or five free segments, while the smaller one has no more than four basally.

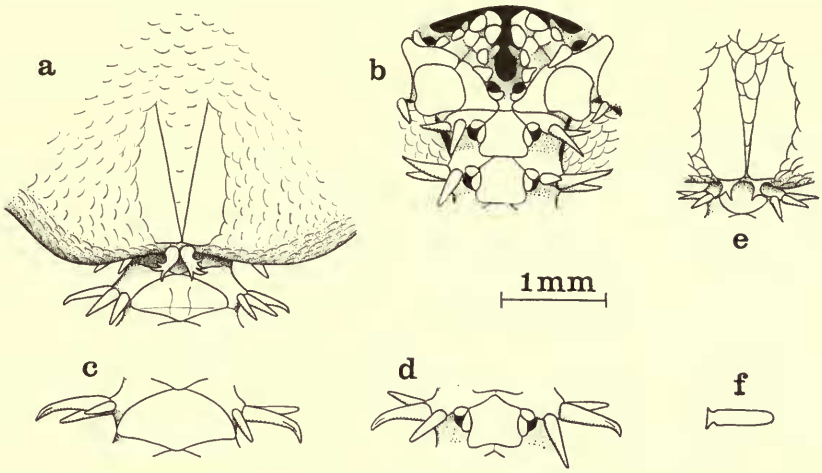


FIG. 4. (a) to (d) *Amphioplus ancistrotus* forma *anisopapilla* nov. Enoshima 24. (a) Dorsal and (b) ventral partial views of disc and oral area, (c) segment with fourteenth dorsal arm plate, (d) segment with twelfth ventral arm plate. (e) and (f) *Amphioplus conductus* Koehler, holotype, U.S.N.M. no. 41161, (e) a pair of radial shields with hyaline processes distal to them, (f) the second from lowest arm spine of a middle arm segment. In (a) the dorsal disc scales are very indistinct, also the dorsal arm plate is semi-transparent and the underlying ossicles are indicated below it. In (b) three of the third oral papillae shown are more or less fore-shortened, whereas the fourth has become appressed.

The larger Enoshima specimen of forma *anisopapilla* (fig. 4*a–c*) has the disc 7 mm. in diameter. The radial shields are 1·3–1·45 mm. long and 0·4 mm. in maximum width ; the proximal angle is acute. The smaller specimen from the same locality has the disc 3 mm. across and differs in having the oral shields longer and more acute proximally. The Sagami Bay specimen has the disc diameter just over 7 mm. and, unlike the other two, has the primary rosette just distinct ; its radial shields are smaller, with length : breadth 0·8 : 0·2 mm. and only the third oral papilla is spiniform.

There are a few species of *Amphioplus* which similarly have the middle oral papillae spiniform, but all of them have only a single tentacle scale. They include *A. dispar* (Koehler), 1897, from the Indian Ocean, *A. aciculatus* from off the Congo and *A. acutus* from the Antarctic, both species of Mortensen, 1936 (Discovery Report), also *A. gastracantha* and *notacantha* (Lütken and Mortensen), 1899, from the East Pacific, though the two last-named differ further in having a few disc spinelets so that they may not be referable to *Amphioplus* at all but to *Amphiacantha*.

*Amphioplus ancistrotus* is closely comparable with *A. diacritus* Murakami (1943, p. 225), the type of which has the disc diameter as much as 10 mm. The plates of

the primary rosette in *A. diacritus* are small but distinct, the radial shields appear to be longer and narrower than in *ancistrotus* and not so divergent, also the arm spines number only three even at this large size, the middle one the longest but evidently not hooked at the tip (though, as all the arms are said to be broken at the base, since specialized spines only develop further out on the arm, in most Amphiurid species that have them, it is possible that all the segments with hooks have been lost). *A. diacritus* is possibly more closely related to *A. rhadinobrachius* H. L. Clark, another Japanese species with only three arm spines. It is noteworthy that in Murakami's figure of *A. diacritus* there are paired processes distal to the radial shields though none are mentioned in his description.

A few other species of Amphiurids from the western Pacific have similar processes. One such is *Amphiacantha acanthina* (H. L. Clark), also from Japan, which has distal angles to the dorsal arm plates like *Amphioplus ancistrotus* but differs in having only three arm spines as well as in the generic character of possessing spines on the disc. A second species is *Amphioplus conductus* Koehler from the Philippines, in the holotype of which I found paired hyaline bifurcating digits distal to the radial shields (fig. 4*d*) not observed by Koehler. The only significant differences I can see between *conductus* and *ancistrotus* are that, at a disc diameter of 6 mm., *A. conductus* already has six arm spines on some basal segments and the second of these is not hooked but bifurcated ; also the dorsal arm plates lack the marked distal angle.

### ***Amphioplus asterictus*** H. L. Clark

(Text-fig. 5)

*Amphioplus asterictus* H. L. Clark, 1915, 252, pl. vii, fig. 9–11.

MATERIAL. Haberer, Sagami Bay, 7.vii.1904, 1 specimen lacking the disc.

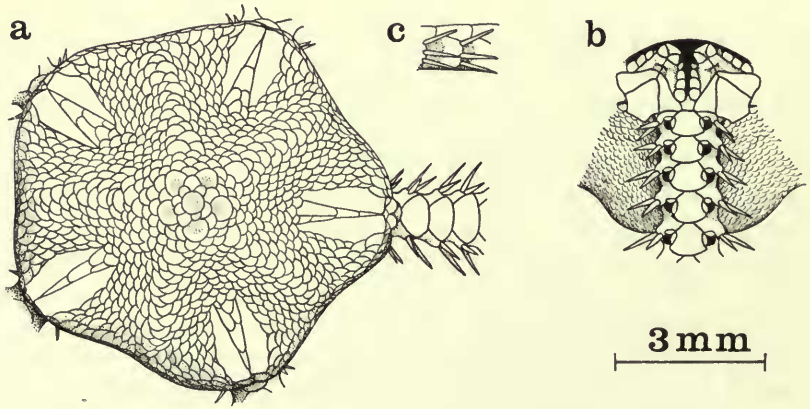


FIG. 5. *Amphioplus asterictus* H. L. Clark. Holotype, M.C.Z. no. 1486. (a) Disc and one arm base viewed dorsally, (b) two jaws and part of the disc viewed ventrally, (c) spines of two proximal segments. In (a) the primary disc scales are slightly hollowed, not thickened.

Since H. L. Clark published only photographs of the type, I give here a drawing of it which I was able to make at the Museum of Comparative Zoology, thanks to the kindness of Dr. Elisabeth Deichmann.

### *Amphioplus japonicus* forma *parvus* (Matsumoto)

*Amphioplus relictus* (part), Koehler, 1922, 180, pl. lxxi, figs. 7, 8; Fell, 1962, 17. [Non *A. relictus* (Koehler), 1898].
*Ophiophragmus japonicus* var. *parvus* Matsumoto, 1941, 334–336, figs. 3, 4.

Material. Döderlein: Tango, 40 fathoms (73 metres), 1 specimen; Tango 4, 7 specimens; Kagoshima, 6 specimens; no details, 7 specimens.

The generic position of *Ophiophragmus japonicus* has been the subject of some controversy. Matsumoto (1915) included the species in *Ophiophragmus* because of the erect marginal scales, despite the fact that it has four oral papillae. Since the possession of only three papillae is partly diagnostic of *Ophiophragmus*, H. L. Clark (1918, p. 271) referred *japonicus* to *Amphioplus* noting that the erect "fence" of marginal scales is *not* homologous with the articulated marginal papillae or spinelets found in the other species of *Ophiophragmus*, including the type, *O. wurdemanni* (Lyman), 1860 (of which no good figures existed up to that time, Koehler (1914) having confused the issue by publishing photographs of *Amphiodia limbata* under the name of *Ophiophragmus "wundermanni"*). Likewise H. L. Clark referred *Ophiophragmus affinis* Duncan, 1887, to *Amphioplus* [where the name became invalid as a homonym of *A. affinis* (Studer)], noting that it is probably identical with *A. relictus* (Koehler), 1898. Matsumoto had considered Duncan's *affinis*, which came from the Bay of Bengal, to be a close relation of *japonicus* together with *Amphipholis andreae* Lütken, 1872, from Java, *Amphiura praestans* Koehler, 1905, from the Flores Sea and *Amphiodia periercta* H. L. Clark, 1911, from Alaska and Oregon, U.S. [The last-named of these is a true *Amphiodia* but the others are currently referred to *Amphioplus*.]

In 1922 Koehler also referred *affinis* Duncan, as well as his own *Amphiura relictus*, to *Amphioplus* on the grounds of differences in the internal structure in comparison with *Ophiophragmus wurdemanni*.

In 1941 Matsumoto noted that the additional oral papilla above the main series of superficial papillae (alternatively called the first oral tentacle scale) is absent in *japonicus* unlike the type species of *Amphioplus*, *A. tumidus* (Lyman). Accordingly he disagreed with H. L. Clark's transfer of the species to *Amphioplus* and retained it in *Ophiophragmus*. Having removed the three distal oral papillae of one series in a specimen from this collection, I can confirm that Matsumoto's observation is correct. However, in the closely related species *Amphioplus hastatus* (Ljungman) the oral tentacle scale may not be visible in some specimens, even when the overlying papillae are displaced, though its development is clearly variable since in others a small scale or papilla can be distinguished. *A. hastatus* may also have spinous projections on the uppermost row of ventral scales similar to those occurring in *japonicus*, as Mortensen (1940, Echinoderms from the Iranian Gulf) has shown.

| Disc diameter (mm.) | Arm length (mm.) | A.l. : d.d. (× : 1) | No. of scales across interradius | Radial shields Length (mm.) | Radial shields Breadth (mm.) | Radial shields l : br (× : 1) | Disc r (mm.) | R.s.l. : disc r (× : 1) |
|---|---|---|---|---|---|---|---|---|
| 2·5 | — | — | 5–7 | 0·53 | 0·26 | 2·05 | 1·25 | 0·42 |
| 2·5 | — | — | 7 | 0·50 | 0·25 | 2·00 | 1·25 | 0·40 |
| 2·75 | — | — | 7–9 | 0·63 | 0·26 | 2·40 | 1·40 | 0·45 |
| 3·1 | 16 | 5·2 | *c.* 7 | 0·70 | 0·29 | 2·40 | 1·55 | 0·45 |
| 3·3 | — | — | 7–9 | 0·74 | 0·29 | 2·55 | 1·65 | 0·45 |
| 3·7 | 21 | 5·7 | 7–9 | 0·74 | 0·33 | 2·25 | 1·85 | 0·40 |
| 4·0 | — | — | 9 | 0·74 | 0·40 | 1·85 | 2·00 | 0·37 |
| 4·0 | *c.* 27 | 6·7 | *c.* 7 | 0·74 | 0·35 | 2·10 | 2·00 | 0·37 |
| 4·0 | — | — | 9 | 0·74 | 0·37 | 2·00 | 2·00 | 0·37 |
| 4·0 | — | — | 7 (8) | 0·75 | 0·37 | 2·00 | 2·00 | 0·39 |
| 4·3 | *c.* 26 | 6·0 | 9 | 0·80 | 0·37 | 2·15 | 2·15 | 0·37 |
| 4·4 | 26 | 5·9 | 9 | 0·74<br>0·80 | 0·34<br>0·40 | 2·20<br>2·00 | 2·20 | 0·34<br>0·37 |
| 4·5 | — | — | 9 (11) | 0·71 | 0·38 | 1·85 | 2·25 | 0·32 |
| 4·6 | *c.* 27 | 5·8 | *c.* 9 | 0·75 | 0·35 | 2·15 | 2·30 | 0·33 |
| 5·0 | *c.* 26 | 5·2 | *c.* 11 | 0·80 | 0·40 | 2·00 | 2·50 | 0·32 |
| 5·0 | *c.* 27 | 5·4 | 9–11 | 0·79 | 0·34 | 2·30 | 2·50 | 0·32 |
| 5·0 | — | — | 9 | 0·82<br>0·87 | 0·42<br>0·50 | 1·95<br>1·75 | 2·50 | 0·33<br>0·35 |
| 5·1 | 26+ | 5·1+ | 11 | 0·84 | 0·40 | 2·10 | 2·55 | 0·33 |
| 5·2 | 31·5 | 6·0 | 9 | 0·76 | 0·34 | 2·25 | 2·60 | 0·29 |
| 5·25 | — | — | 11 | 0·87 | 0·34 | 2·55 | 2·60 | 0·33 |
| 8·4 | — | — | 11 | 1·00<br>1·10 | 0·53<br>0·55 | 1·90<br>2·00 | 4·20 | 0·24<br>0·26 |
| Range 2·5–8·4 | 16–31·5+ | 5·2–6·7 : 1 | 5–11 | 0·53–1·10 | 0·25–0·55 | 1·75–2·55 : 1 | 1·25–4·20 | 0·24–0·45 : 1 |
| Mean | | 5·7 : 1 | | | | 2·1 : 1 | | 0·36 : 1 |

*Amphioplus japonicus* forma *parvus*. Some measurements and ratios of 21 specimens, three of them with varying proportions for the radial shields.

Accordingly, together with Fell (1962), I agree with H. L. Clark that *japonicus* is better referred to *Amphioplus*, although I believe that, together with *A. hastatus, depressus, relictus, andreae, laevis, praestans, megapomus, miyadii* and some others, it may be possible to distinguish it as forming part of a subgenus marked off from *Amphioplus tumidus*, the type species of the genus, by the reduction of the oral tentacle scale coupled with linear arrangement of the oral papillae, contiguity of the radial shields and enlargement of the two tentacle scales of each arm pore.

The present specimens are referred to Matsumoto's forma *parvus*, of *A. japonicus* because none of them have the row of enlarged outermost dorsal disc scales shown by Matsumoto in his figures of *japonicus* itself. I have not seen any specimens of the latter and am unable to assess whether or not the forma is worth retaining.

The table given here shows some measurements of 21 specimens of *A. japonicus* forma *parvus*. It indicates that the relative size of the radial shields decreases as growth proceeds, from a maximum of just under half the disc radius at about 3 mm. disc diameter to a minimum of only a quarter when the diameter is over 8 mm. Since this ratio has been used to distinguish between related species belonging to this section of the genus *Amphioplus* it is clearly advisable that the total size of the disc should be taken into account when making such comparisons.

When describing *parvus* in 1941, Matsumoto commented that it is allied to *Amphioplus megapomus* H. L. Clark. Having examined the discless type specimen of *megapomus* I cannot agree with this. The dorsal arm plates of *megapomus* have a median distal peak, so appearing trilobed, and the arm spines are much more acute than in *japonicus*. In 1915, H. L. Clark noted that complete specimens of *A. megapomus* have relatively wide radial shields as in *A. japonicus*. Despite this, I believe that *A. megapomus* is more likely to prove conspecific with *A. miyadii* Murakami, 1943, also of Japanese origin, since it agrees in the oral structure and in the distinctive trilobed dorsal arm plates. Regeneration of the disc in those species of *Amphioplus* which are particularly liable to shed it, such as *A. integer*, results at first in abnormally short radial shields, though their relative length increases as growth proceeds. If the specimens with discs studied by Clark in 1915 were regenerating, the shields would probably be abnormally short. However, another possibility is that these intact specimens were not conspecific with the types of *megapomus* since Clark noted that their arm plates were not identical. *A. miyadii* is certainly more closely related to *A. laevis* (Lyman) and *praestans* (Koehler) with similarly elongated radial shields, than it is to *A. japonicus*.

In contrast to the type of forma *parvus*, the majority of the present specimens have the six primary plates distinct, if not by larger size then by a slight hollowing of their surface. In the smallest specimens the primaries are partly contiguous with each other, having interstitial scales only at their corners (as in Koehler's photograph of the small type of *A. hastatus* (1927), *Ark. Zool.*, **19**, pl. 3, fig. 2) but in larger specimens the primaries are more or less widely separated.

In 1922 Koehler referred sixty-four specimens from Kagoshima, Japan, as well as a number of Philippine specimens to *Amphioplus relictus*, noting that the relative width of the oral shields is variable and that some specimens (of which he figures one

from Kagoshima) have a distinct marginal row of erect disc scales. I have found that some of the specimens earlier (1905) identified as *A. relictus* by Koehler, at least those from " Siboga " stations 51 and 71 (Makassar and Molo Strait in the East Indies), have a distinct enlarged row of marginal disc scales contrasting with the uppermost row of smaller ventral scales, which are erect and project to form a scalloped edge to the disc, as in some specimens of *A. japonicus*. Nevertheless, I think that Koehler's Kagoshima specimens are more likely to be referable to *A. jpaonicus* than *relictus* since the ventral view of one (1922, pl. 71, fig. 7) suggests that the distal edge of the oral shields is simply convex as in all the present specimens, without having a distinct, more or less constricted, distal lobe, as occurs even in Koehler's Manila specimen (pl. 71, fig. 6) where the shields are particularly wide in comparison with those of most Philippine and East Indian examples of the species, in which the distal lobe is usually as long as the proximal angle. [In the Manila specimen the shape is very like that found in one of the syntypes of *A. andreae*, seen by me at the Museum of Comparative Zoology, and it is possible that it should have been referred to *andreae* and not to *relictus*.]

As these remarks indicate, the distinctions between *Amphioplus hastatus, depressus, relictus, andreae* and *japonicus* are very subtle and in need of further consideration when a true assessment of variation and growth changes can be made together with re-examination of the types.

### *Amphiodia craterodmeta* H. L. Clark

*Amphiodia craterodmeta* H. L. Clark, 1911, 155–157, fig. 65 ; Matsumoto, 1917, 182 ; Djakonov, 1938, 463 ; 1949, 54, fig. 72 ; 1954, 62.
*Diamphiodia craterodmeta* : Fell, 1962, 14.

Material. Domaschnew, nos. 53 and 55, 20.vi.1900 and 27.vii.1900, 4 specimens ; Brashnikow, no. 6, July, 1899, 2 specimens ; Schmidt, nos. 9 and 10, Mauka, south-west Sakhalin, 46–47 sagenes (*c.* 100 metres), 8.vi.1901, 19 specimens. (All N. Japan Sea).

Of the two specimens from Brashnikow's number 6, the larger has the disc diameter 8 mm. and the smaller 4·5 mm. The former has no distinct primary disc scales, the oral shields are very small with the distal lobe both sunken and constricted, also the infradental papillae are widely spaced and head the series of three oral papillae each side and the disc plates are all extremely well-defined. The smaller specimen from no. 6 differs in having the primaries much larger than the other scales.

In comparison with *Amphiodia fissa*, this species differs in having narrower (but still mainly contiguous) radial shields, entire dorsal arm plates, smaller oral shields and larger adorals, the primary disc scales not so different from the other scales, four arm spines proximally and the ventral tentacle scales longer.

### *Amphiodia fissa* (Lütken)

(Text–fig. 6)

*Amphipholis fissa* Lütken, 1869, 12–13 (30–31).

*Amphiodia rossica* Djakonov, 1935, 465, figs. 7 and 8 ; 1938, 465–466, fig. 8 ; 1949, 55, fig. 71 ; 1954, 64, fig. 18.
*Diamphiodia fissa* and *rossica* : Fell, 1962, 14.

MATERIAL. Schmidt, nos. 3 and 5, Mauka, south-west Sakhalin, 20 and 15 sagenes (42 and 31 metres), 3.vi.1901 and 4.ii.1901, 5 specimens ; no. 21, Posjet Bay, near the bay of Minanosok, 12 sagenes (26 metres), 6.iv.1900, 4 specimens ; no. 81, entrance to the bay of Tshogu-tschien-dogu, 11 specimens.

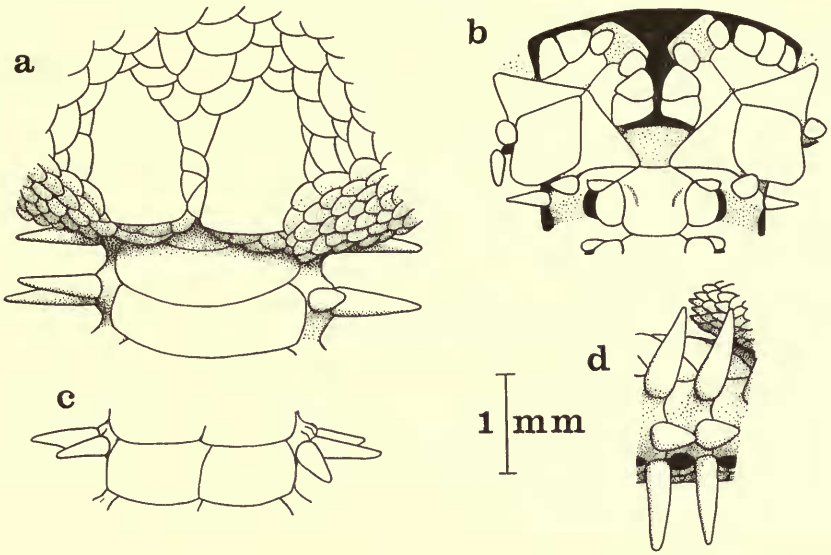


FIG. 6. *Amphiodia fissa* (Lütken). Specimen from Peter the Great Bay, M.C.Z. no. 4622, labelled as *A. rossica* Djakonov. (a) Dorsal and (b) ventral views of parts of the disc and oral area, (c) segment with fifteenth (split) dorsal arm plate, (d) lateral view of an arm base showing the individually projecting disc scales ; the middle arm spines fore-shortened.

NOMENCLATURE. Lütken described this species in Danish from material collected on the Amur coast (i.e. probably in the vicinity of Vladivostok), giving also a short latin diagnosis but no figures. The very unusual feature for an Amphiurid of the subdivided dorsal arm plates, which gave the species its name, taken in conjunction with the peculiar erect marginal scales of the disc, leaves me in no doubt that *Amphiodia rossica* Djakonov (also from the Amur region), which shares these characters, was based on material of this same species. In his original description of *Amphiodia rossica* (1935) Djakonov made no mention of *Amphipholis fissa* but in 1954 he commented on the possible identity of the two ; however, with no published figure of the type of *A. fissa* in existence he evidently thought that sufficient doubt exists to justify the continued use of the name he had himself established.

Since Lütken's name *Amphipholis fissa* has remained in oblivion for well over 50 years, I submitted to the International Commission on Zoological Nomenclature a petition to obtain the suppression of the name *A. fissa* as a *nomen oblitum*. This case

is suspended in view of the controversy regarding *nomina oblita* in general raised at the last colloquium on nomenclature.

Remarks. The smallest of the five specimens from Mauka has the disc diameter only 3·5 mm. and the proximal tentacle scale on the lateral plate is reduced or absent on all but the basal pores, though the scale on the ventral arm plate is quite large. The dorsal arm plates are nearly all split and fairly regularly so, also the marginal disc scales are erect. In another small specimen with disc diameter 3 mm. the ventral scale is also absent on segments beyond the tenth and sometimes as far proximally as the fifth. The larger specimens have the disc diameter about 10 mm.

Yet another small specimen, with disc diameter only 2·75 mm., has the dorsal arm plates fan-shaped and not split. It also has the plates of the primary rosette in direct contact with each other, whereas in specimens with disc diameter 5 mm. or more the primaries are all separated. The splitting of the dorsal arm plates seems to start with the distal plates and progress proximally, but even when the plates are not split the arms appear distinctly carinate. One specimen with disc diameter 4·5 mm. has the first five to seven plates entire ; it also has three arms regenerating, each with a soft, worm-like tip, not yet distinctly segmented. There are two tentacle scales only to about the twentieth segment, then one.

Other variable characters include the erection of the marginal disc scales, which may be lacking, also the development of the distal lobe of the oral shields.

Since Djakonov's figures are unnatural with regard to the mouth parts and not quite in agreement with the specimens I have seen, it seems worthwhile to give here a figure of an oral angle drawn from a specimen presented by Djakonov to the Museum of Comparative Zoology, Harvard.

## Family **OPHIOTRICHIDAE**

### ***Ophiothrix*** sp. ?***eusteira*** H. L. Clark

*Ophiothrix eusteira* H. L. Clark, 1911, 265–267, fig. 132 ; Matsumoto, 1917, 222–223, fig. 60.

Material. Döderlein, 7.xi.1881. III, 170 fathoms (311 metres), 1 specimen.

The single specimen has the disc diameter 7·5 mm. The radial shields are large, *c.* 2·4 mm. long, and completely bare. The disc scales are clearly visible below the sparse covering of small, spaced, tapering stumps, though some have about three long thorns remaining on their tips. In the middle of the disc are a few short spines only, agreeing more with Matsumoto's figured specimen than with the holotype, which has the central spines very long. There is more resemblance to the specimen figured by Koehler (1922, pl. 45, fig. 6) under the name of *Ophiothrix koreana*, which I think would be better referred to *O. eusteira* in view of my observations (below) about the types of *O. koreana*.

This specimen is only doubtfully identified as *Ophiothrix eusteira* because it already has as many as nine arm spines on the second free segment, whereas the holotype, with disc diameter 1·5 mm. greater, has only six or seven spines, according to H. L. Clark.

## *Ophiothrix koreana* Duncan

(pl. I, figs. 3 and 4.)

*Ophiothrix koreana* Duncan, 1879, 473–476, pl. xi, figs. 28–32; H. L. Clark, 1911, 257–262, figs. 127–128; Matsumoto, 1917, 220; Murakami, 1942, 20; 1943, 232–233; 1944, 267; Djakonov, 1954, 88.

MATERIAL. Döderlein: Yogashima, 3 specimens; Yogashima, 2.xi.1881, 3 specimens; Yogashima 2 & 3.xi.1881, 1 specimen; Enoshima 18, 183 metres, 8.xi.1881.II, 1 specimen; Tango, 73 metres, 2 specimens.

Duncan's figures of the syntypes of *Ophiothrix koreana* were not very good so I give here photographs of the upper surfaces of two of them. These show that, unlike the specimens figured under the name of *koreana* by H. L. Clark, which subsequent writers have taken as models of the species, their radial shields carry a number of thorny, mostly trifid, stumps at their distal ends as well as proximally, though the stumps appear more sparse on the shields than on the scales. The largest syntype, with disc diameter 8 mm., has about 30 stumps on each radial shield including four or five at the distal tip, while the smallest specimen, disc diameter 4·5 mm., has about 12 stumps on each shield. This smallest syntype, as well as one other out of the six, has some thorny disc spines in addition to the stumps but the remaining four have no spines and superficially resemble H. L. Clark's figure of *Ophiothrix hylodes* (1911, p. 263, fig. 130), which Matsumoto and subsequently Clark himself referred to the synonymy of *Ophiothrix marenzelleri* Koehler, 1904*a*. The type of *hylodes* has the disc stumps (or "stout, blunt, rough spines" in Dr. Clark's terminology) with irregular thorns along their lengths and at their tips rather than the trifid form found in the types of *O. koreana* and also in the specimens identified as *O. marenzelleri* by Koehler (1922). However, some of the specimens of the present collection also have "stumpy spines" of this kind, so the form of the stumps cannot be considered as diagnostic. H. L. Clark did not mention *O. marenzelleri* in his work of 1911, but commented that *O. hylodes* might be "only an extreme variety of *koreana*". Matsumoto repeated this supposition and noted that "the sublittoral form (of *marenzelleri*) approaches *O. koreana* more closely than the littoral form", this sublittoral form sometimes having a few long spines on the disc as well as the close covering of thorny stumps or tubercles. Matsumoto did not comment on the density of tubercles on the radial shields as being any less in the littoral form than in the sublittoral but Koehler (1904*a*, p. 104) noted that in the types of *O. marenzelleri* the radial shields are almost as closely covered with stumps as the rest of the disc.

In the present collection I have identified as *O. marenzelleri* specimens in which the stumps appear equally dense on the radial shields as on the rest of the disc and those with the radial shields distinctly barer I have named *O. koreana*. However, so close are the types of *O. koreana* to the form generally accepted as *O. marenzelleri* that I think the latter name might well be considered a synonym. Judging from the variation of *Ophiothrix fragilis* in the north Atlantic it is quite possible that the Japanese specimens hitherto designated as *koreana, marenzelleri, hylodes* and possibly even *eusteira* H. L. Clark, 1911, all represent a single very variable species. Alternatively the specimens with almost or completely bare radial shields such as those

figured under the name of *O. koreana* by H. L. Clark in 1911 might be referred to *O. eusteira*. A much larger collection than that available to me is necessary before a proper assessment of this problem can be made, so notorious is the genus *Ophiothrix* for its variability.

### ***Ophiothrix stabilis*** Koehler

*Ophiothrix stabilis* Koehler, 1904*a*, 84–86, figs. 46–49 ; Matsumoto, 1917, 224 ; Murakami, 1944, 268.
*Ophiothrix ciliaris :* H. L. Clark, 1911, 257. [Non *O. ciliaris* (Lamarck), 1816.]

Material. Schmidt, 1901, Nagasaki, 3 specimens.

These three specimens were taken with one which I have referred to *Ophiothrix marenzelleri*. They are immediately distinguishable from it by the disc stumps which are shorter and better-termed tubercles than stumps ; they also have a coronet of usually five to seven divergent points. Some disc spines are also present as in the holotype *O. stabilis* but there is a difference in the shape of the ventral arm plates. None of these have the distal edge markedly convex as Koehler describes it in the holotype (though his figure may not be reliable since it shows the ventral-most arm spines with their hooks directed inwards instead of outwards or proximally, when aligned perpendicularly, as in other species of *Ophiothrix* and in the three specimens of *O. stabilis* in the present collection).

Since Matsumoto used the convex or concave shape of the distal edge of the ventral arm plates as an important character in his key to the Japanese species of *Ophiothrix*, the identification of these three specimens as *O. stabilis* invalidates this particular dichotomy of his key. This dichotomy was already untrue for *O. eusteira*, included with *stabilis* as having convex edges to these plates, whereas only two proximal plates are so depicted in H. L. Clark's figure of *eusteira* and none at all in Matsumoto's own figure, where all the plates appear incurved in the middle of the distal side.

### ***Ophiothrix panchyendyta*** H. L. Clark

*Ophiothrix panchyendyta* H. L. Clark, 1911, 264–265, fig. 131 ; Matsumoto, 1917, 219.

Material. Okinose Bay, 600 metres, 1 specimen.

The disc spines appear longer than shown in H. L. Clark's figure of the type. The disc diameter of this specimen is 10·5 mm. and the majority of the spines towards the centre of the disc are 1·7–2·0 mm. long. The length of the corresponding spines was not specified in the type. There are hardly any short stumps on the disc besides the spines. Close to the proximal interradial edge of each radial shield is a row of four to eight short, tapering thorny-tipped spines or stumps, but superficially the radial shields appear relatively large and very bare. There is no spine in the middle of the first dorsal arm plate, unlike the type of *O. panchyendyta*, but the arm plates are similarly conspicuously granular in surface texture. Although H. L. Clark suspected that neither of these last two characters might prove to be diagnostic, the latter at least holds good for this specimen.

### *Ophiopsammium rugosum* Koehler

*Ophiopsammium rugosum* Koehler, 1905, 116–117, pl. xiii, figs. 4–6; 1930, 197.

MATERIAL. Sprater, Gulf of Siam, 1910/4500, clinging to a pennatulid, 10 specimens.

The outlines of the radial shields are visible through the skin and granules. The disc spines are very variable in occurrence, even in different interradii of the same specimen; there may be just two widely separated spines right on the edge of an interradius or about 10 conical spines more or less inset or some shorter conical tubercles (all these with truncated tips). One specimen has two to four very short, thick, pointed tubercles in each dorsal interradius level with the tangent to the distal ends of the radial shields, then at the very edge of the disc or slightly towards the ventral side there are two separate clusters each of about four short conical spines. Another specimen has about 35 very large low granules in the central part of the disc and central interradial areas, not projecting out of the skin.

The colour of the disc is pinkish dorsally and dark-red ventrally. There are also patches of intense black spots dorsally of varying extent and conspicuousness in the different specimens. One has particularly large spots in asymmetrical areas of the disc and arms, so that one pair of radial shields and one adjacent shield are covered with big spots and one pair with only fine spots, while the rest are parti-coloured. On the arms the spotted patches extend over about four segments. The tube feet are dark red.

These specimens appear to have been epizooic on the pennatulid, since they are well entwined within its branches. Possibly the peculiarities of the genus are correlated with this habit.

## Family **OPHIODERMATIDAE**

### *Ophioconis permixta* Koehler

*Ophioconis permixta* Koehler, 1905, 14–15, pl. ii, figs. 4 & 7 (5 in caption).
*Ophiurodon permixtus*: Matsumoto, 1915, 84; 1917, 315; Koehler, 1922, 352.

MATERIAL. Xenia reef, Dar-es-Salaam, Tanganyika, 3 specimens.

The use of the original generic name for this species results from a comparison between the three present specimens and two examples in the British Museum collections of *Ophioconis forbesi* (Heller), 1863, the type species of *Ophioconis* Lütken, 1869, one specimen from the Adriatic originating with Dr. Heller himself and the other from La Ciotat in the south of France. Unfortunately I have no material of *Ophioconis grandisquama* Koehler, 1904, the type species of *Ophiurodon* Matsumoto, 1915 but there are several examples in the British Museum collection of *Ophioconis cupidum* Koehler, which Matsumoto referred to *Ophiurodon* together with *Ophioconis cincta* Brock and *O. permixta* Koehler, all of which I consider to be congeneric with *Ophioconis forbesi*.

Matsumoto's restricted *Ophioconis* included only *O. forbesi* and *O. brevispina* Ludwig, 1880, both from the Mediterranean and neither known to Matsumoto at

first hand. He distinguished *Ophioconis* from *Ophiurodon*, *Ophiuroconis*, *Ophiurochaeta*, *Ophiolimna* and *Ophiarachna* by the arm spines, which he said are " very short, lying flat on the arm, hyaline ". In fact the dorsal arm spines of the first two free segments on both specimens of *Ophioconis forbesi* seen by me are equal to or even slightly longer than the corresponding dorsal arm plates and in the better-preserved (French) specimen (pl. I, figs. 1 & 2) most of the spines are erect, only those of the distal parts of the arms having become flattened against the arms in preservation. In *Ophioconis brevispina* and in *O. vivipara* Mortensen, 1925, from Morocco, the arm spines are much shorter, only about half as long as the corresponding segments near the bases of the arms, judging from the figures, but it is *O. forbesi* which is the type species and criterion of the genus.

The three specimens of *O. permixta* in the Münich collection are all small, with the disc diameter little more than 3 mm. but their arm spines have very similar proportions and alignment to those of *O. forbesi* and, apart from the scattering of spinelets among the granules of the disc, there is little difference between them, certainly not enough to warrant a generic separation. Hertz (1927) has described a subspecies *nueva* of *Ophiurodon grandisquama* based on four specimens from Madeira. She maintains that these are very similar to a Japanese specimen of *O. grandisquama* which she has studied. Certainly the arm spines appear from her photographs to be relatively longer than those of *Ophioconis forbesi*, since most of the spines of the proximal half of the arm exceed or at least equal the segments in length. Nevertheless I can see no difference of sufficient magnitude to justify generic separation. If Hertz is right in asserting that *nueva* is closely related to *grandisquama* then *Ophiurodon* must be considered as a synonym of *Ophioconis*. However, this needs confirmation from a study of Japanese specimens. Certainly I do not think that the presence of disc spinelets in *permixta* warrants a generic distinction from *Ophioconis forbesi*, particularly as H. L. Clark (1938) has found the occurrence of such spinelets in the related species *Ophioconis cincta* Brock to be very variable. In eleven specimens from northern Australia he found that five had a distinct marginal fringe of disc spinelets, as in the type of *cincta*, while five others had these marginal spinelets poorly developed or absent and the last specimen had both marginal and dorsal spinelets, as in *O. permixta*. This last observation casts doubt on the validity of *permixta* as distinct from *cincta*, but much better sampling of these rather inconspicuous ophiuroids is needed before a true appreciation of the specific limits can be reached. *Ophiurodon cupidum* should also be referred to *Ophioconis*; having no disc spinelets it is the Indo-Pacific counterpart of the Mediterranean *Ophioconis forbesi*, the main difference being only of colour pattern.

In the small specimens of *O. permixta* the second tentacle scale is present for the first six to twelve segments, on one arm even to the seventeenth.

This record from East Africa provides a considerable extension of range for *Ophioconis permixta*, which was previously known only from the East Indian area.

### ***Pectinura anchista*** H. L. Clark

*Pectinura anchista* H. L. Clark, 1911, 23–25, fig. 1 ; Matsumoto, 1917, 322.

MATERIAL. Haberer, no. 4168 (pt.), Sagami Bay, between Ito and Hatsushima Island, *c.* 150 metres, March 1903, 2 specimens.

Matsumoto thinks that *Pectinura anchista* may be a synonym of *P. cylindrica* (Hutton), 1872, from New Zealand. On morphological grounds it seems to me to be equally likely that *anchista* is synonymous with *P. aequalis* (Lyman), 1880 and on zoogeographical grounds *more* probable since the " Challenger " collected *aequalis* off New Guinea and it has since been recorded by Koehler (1904 and 1922) from the vicinity of Celebes and from the Philippines, while Murakami (1944) records it from Yaeyama, Japan. Murakami did not state the size of his specimens but Lyman's type of *P. aequalis* has the disc diameter 25 mm. and Koehler's Philippine specimens are equally large or larger still. The presence of 10 arm spines in Koehler's specimens, whereas these from Sagami Bay have only seven proximally, may be attributable to the much smaller size of the latter, the disc diameter being only 11 or 12 mm. The holotype of *P. anchista* also has seven arm spines ; its disc diameter is 14 mm. I think that a direct comparison between Japanese and East Indian specimens of similar size will show the two to be indistinguishable.

## Family **OPHIURIDAE**

### ***Aspidophiura uniumbonata*** Murakami

*Aspidophiura uniumbonata* Murakami, 1942, 21–22, fig. 8.

MATERIAL. No details, presumably southern Japan, 1 specimen.

The disc diameter is 4·5 mm. and the longest stump of arm remaining attached is only 3·5 mm. long. There is a suggestion of a boss on the central disc plate as in the type of *Aspidophiura uniumbonata*. Two of the five primary radials are irregularly subdivided but the other three are regular and about equal in size to the radial shields. The oral shields are wider than in either *A. watasei* or *A. forbesi* but agree with those of the type of *uniumbonata*. The only difference from the type is that the uppermost arm spine of at least the first and second free segments is just longer than the segment and the middle arm spine too is relatively longer, almost equal to the segment in length. In the two other species the spines are shorter.

A number of other species were included in the collection for which no particular comment was elicited. They are as follows :

*Southern Japan*

*Astrodendrum sagaminum* (Döderlein)

Haberer, no. 4118, Fukuura, Sagami Bay, *c.* 150 metres, 1–2.iii.1903, 2 specimens.

*Ophiacantha pentagona* Koehler

Doflein, no. 320, Sagami Bay, 180 metres, 25.x.1904, 10 specimens ; Döderlein : Enoshima 14, 1 specimen ; Enoshima 22, 2 specimens ; 2.xi.1881, IV, 1 specimen.

*Ophiopholis mirabilis* (Duncan)

Doflein : Yogashima (Misaki), 150 metres, 31.x.1904, 4 specimens ; Sagami Bay, towards Boshu, 120 metres, 1.x.1904, 1 specimen ; Haberer, Fukuura, Sagami Bay, March, 1903, 1 specimen ; (Haberer?), no. 4356, Sagami Bay 7.vii.1904, 1 specimen.

*Ophiopholis* sp.? *brachyactis* H. L. Clark

Döderlein, Enoshima 18, 8.xi.1881, II, 1 specimen.

*Ophiactis pteropoma* H. L. Clark

Döderlein : Enoshima 25, 2 specimens ; 2.xi.1881, III, 1 specimen.

*Amphipholis sobrina* Matsumoto

Döderlein, Enoshima 22, 1 specimen ; Tango, 40 fathoms (73 metres), 1 specimen.

*Amphiacantha acanthina* (H. L. Clark)

Doflein, station 16, no. 22b, 3 specimens.

*Ophiothrix marenzelleri* Koehler

Schmidt, Nagasaki, 1901, 1 specimen ; Haberer, no. 4356, Sagami Bay, 7.vii. 1904, 1 specimen ; Doflein, Yogashima (Misaki), 150 metres, 31.x.1904, 1 specimen ; (Doflein?), Kachiyama, 1 specimen ; Döderlein, 2.xi.1881, III, 2 specimens.

*Ophiomastix mixta* Lütken

Schmidt, Nagasaki, 1.iii.1901, 3 specimens.

*Ophiarachnella gorgonia* (Müller and Troschel)

Schmidt, Nagasaki, February–March, 1901, 1 specimen.

*Ophioplocus japonicus* H. L. Clark

Schmidt, Nagasaki, 1.iii.1901, 1 specimen.

*Ophiura kinbergi* (Ljungman)

Schmidt, Nagasaki, 1 specimen ; Doflein, Tzushi (?), 130 metres, 11.xi.1904, 2 specimens ; Döderlein, Tagawa (?), 7.xi.1881, II, 1 specimen ; (Döderlein?), Tagawa, 1 specimen.

*Ophiozonella projecta* (Koehler)

Döderlein, Yogashima, 1 specimen.

*Ophiozonella longispina* (H. L. Clark)

Haberer : no. 4168 (pt.), Sagami Bay, between Iso and Hatsushima Island, *c.* 150 metres, March, 1903, 20 specimens ; Fukuura, Sagami Bay, March, 1903, 1 specimen ; Döderlein : Enoshima 22, 1 specimen ; 2.xi.1881, III, 1 specimen.

*Stegophiura sladeni* (Duncan)

Haberer : no. 4356 (pt.), Sagami Bay, 7.vii.1904, 1 specimen ; no. 4168 (pt.), Sagami Bay, between Ito and Hatsushima Island, *c.* 150 metres, March, 1903, 1 specimen ; Sagami Bay, 1900, 2 specimens.

*Stegophiura vivipara* Matsumoto

Doflein, no. 582, Uraga Channel, Sagami Gulf, 150 metres, 22.x.1904, 1 specimen ; (Döderlein?), Yogashima, 2 and 3.xi.1881, 4 specimens.

*Ophioleuce charischema* (H. L. Clark)

Döderlein : Enoshima 22, 1 specimen ; Yogashima 2 and 3.x.1881, 1 specimen ; no details, 1 specimen.

*Amur-Sakhalin* (Localities probably east of Vladivostok, unless Sakhalin included).

*Ophiacantha adiaphora* H. L. Clark

Schmidt, no. 64, 19.v.1900, 1 specimen.

*Ophiacantha bidentata* (Retzius)

Schmidt : no. 57, 1 specimen ; no. 48, off Cape Povorotny, 230–196 metres ; 18 specimens.

*Ophiopholis aculeata* (Linnaeus)

Schmidt : no. 68, 24.v.1900, 1 specimen ; no. 46, Strelok Channel, 1 specimen ; Brashnikow : no. 7, June 1899, 1 specimen ; no. 14, June, 1899, 1 specimen ; no. 49, August, 1899, 4½ specimens ; nos. 19 and 14, 1899/1901, 11 specimens ; Domaschnew, no. 59, July, 1900, 1 specimen.

*Amphiura lepidevaspis* Djakonov

Schmidt, no. 10 (pt.), Mauka, S.W. Sakhalin, 46–47 sagenes (*c.* 100 metres), 8.vi.1901, 1 specimen.

*Amphiodia craterodmeta* H. L. Clark

Domaschnew, no. 55, 20.vi.1900, 3 specimens ; no. 53, 27.vii.1900, 1 specimen ; Brashnikow, no. 6 (pt.), July, 1899, 2 specimens ; Schmidt, nos. 9 (pt.) and 10 (pt.), Mauka, S.W. Sakhalin, 46–47 sagenes (*c.* 100 metres), 8.vi.1901, 19 specimens.

*Amphioplus macraspis* (H. L. Clark)

Schmidt, no. 81 (pt.), 1900, 2 discless specimens.

*Stegophiura nodosa* (Lütken)

Schmidt, no. 47, 95–100 (? sagenes), 9.v.1900, 1 specimen.

*Ophiura leptoctenia* H. L. Clark

Schmidt : nos. 8, 9, Mauka, S.W. Sakhalin, 46–47 sagenes (*c.* 100 metres), 8.vi.1901, 5 specimens ; no. 48 (pt.) off Cape Povorotny, 230–196 metres, 1900, 9 specimens ; no. 58, same locality, 200–132 metres, 3 specimens.

*Ophiura quadrispina* H. L. Clark

Schmidt, no. 48 (pt.), off Cape Povorotny, 230–196 metres, 1900, 1 specimen.

*Ophiura sarsi* Lütken

Schmidt : nos. 9, 10 (pts.), Mauka, S.W. Sakhalin, 46–47 sagenes (*c.* 100 metres), 8.vi.1901, 16 specimens ; no. 11, " east facing Patrok Bay (?)," 22.iii.1900, 1 specimen ; no. 30 (locality illegible), 17.iv.1900, 1 specimen ; no. 48 (pt.), off Cape Povorotny, 230–196 metres, 1900, 2 specimens ; no. 69, between Askold and (?) Skriplev Islands, 55 sagenes (*c.* 115 metres), 24.v.1900, 2 specimens : Brashnikow : no. 6 (pt.), July, 1899, 3 specimens ; no. 35, July, 1899, 2 specimens.

*Ophiura sarsi vadicola* Djakonov

Schmidt : no. 18, off Cape Povorotny, 3.iv.1900, 11 specimens ; no. 24, Aniva Bay, S. Sakhalin, 13–14 sagenes (27–29 metres), 28.viii.1901, 1 specimen ; no. 46, Strelok Channel, 48–42 (? sagenes), 8.v.1900, 1 specimen ; no. 69 (pt.), between Askold and (?) Skriplev Islands, 55 sagenes (*c.* 115 metres), 24.v.1900, 1 specimen ; Brashnikow, no. 35, 16.vii.1899, 7 specimens.

*Ophiura maculata* (Ludwig)

Brashnikow : no. 15, June, 1899, 2 specimens ; no. 27, July, 1899, 1 specimen.

*Miscellaneous Localities*

*Asteronyx longifissus* Döderlein

| | | |
|---|---|---|
| Albatross st. 2892 | (Santa Barbara Channel, S. California) | 35 |
| st. 2979 | (Anacapa Island, S. California) | 30 |
| st. 3198 | (off central California) | 23 |
| st. 2891 | (Point Conception, Oregon) | 26 |

*Asteronyx loveni* Müller and Troschel

| | | |
|---|---|---|
| Albatross st. 2923 | (off San Diego, California) | 1 |
| st. 3787 | (off Punta Gorda, N. California) | 1 |
| st. 5637 | (Molucca Islands) | 1 |

*Asteroschema* (or *Ophiocreas*) spp.

(Döderlein, 1927, regards *Ophiocreas* as hardly distinct from *Asteroschema* even at the subgeneric level, but Mortensen and Fell since consider *Ophiocreas* to be a distinct genus. Without the disc no distinction is possible).

Albatross st. 5621 (Molucca Islands) 1 arm
(Döderlein recorded *Asteroschema* (*Ophiocreas*) *gilolense* from this station).

Albatross st. 5634 (Molucca Islands) 1 arm
(Döderlein recorded *A.* (*O.*) *ambonesicum* from this station).

*Amphiura chiajei* Forbes

Villefranche. Dr. Neresheimer 1

*Ophictais savignyi* Müller and Troschel

Ceylon. Haeckel 1

*Ophiactis simplex* (Le Conte)

Academy Bay, Santa Cruz, Galapagos Islands
Foerster, 15.v.1959 2

*Ophiothrix* sp. prob. *fragilis* (Abildgaard)

44° 48′ N : 13° 45′ E (northern Adriatic)
36 metres, 26.ix.1895 1

*Ophiothrix angulata* (Say)

Kingston Harbour, Jamaica. Dr. Heitz, 30.xii.1903 *c.* 50

*Macrophiothrix hirsuta* (Müller and Troschel)

Ras Mohammed, Red Sea. Dr. Hofer, 1892 1

*Ophiothela danae* Verrill

Thursday I. Regenerating 3 arms and half the disc 1

*Ophiocoma scolopendrina* (Lamarck)

Red Sea, Schadwan I. (? spelling), southside. H. Haas, 27.iii.1956 5
Mombasa, E. Africa, May, 1960, Papp 5
Washington Museum, no. 46985, Philippines, E. A. Mearns, 1912 2 (badly damaged)

*Ophioderma cinereum* Müller and Troschel

New Port, Curaçao. Dr. Hellmich, 24.1937 1

*Ophioderma longicauda* (Retzius)

Tunis. Pet. Müller, 13.ix.1960 1

*Bathypectinura conspicua* (Koehler)

Albatross st. 5215 3
st. 5219 2

*Ophionereis albomaculata* E. A. Smith

Academy Bay, Santa Cruz, Galapagos Islands, Foerster, 15.v.1959 5

*Ophiurolepis gelida* (Koehler)

German Südpolar-Expedition : 25.vi.1902 4
17.iv.1902, 385 m. (one infested with sponge *Iophon*) 9
12.viii.1902 (largest with *Iophon*) 5
14.iv.1902 2

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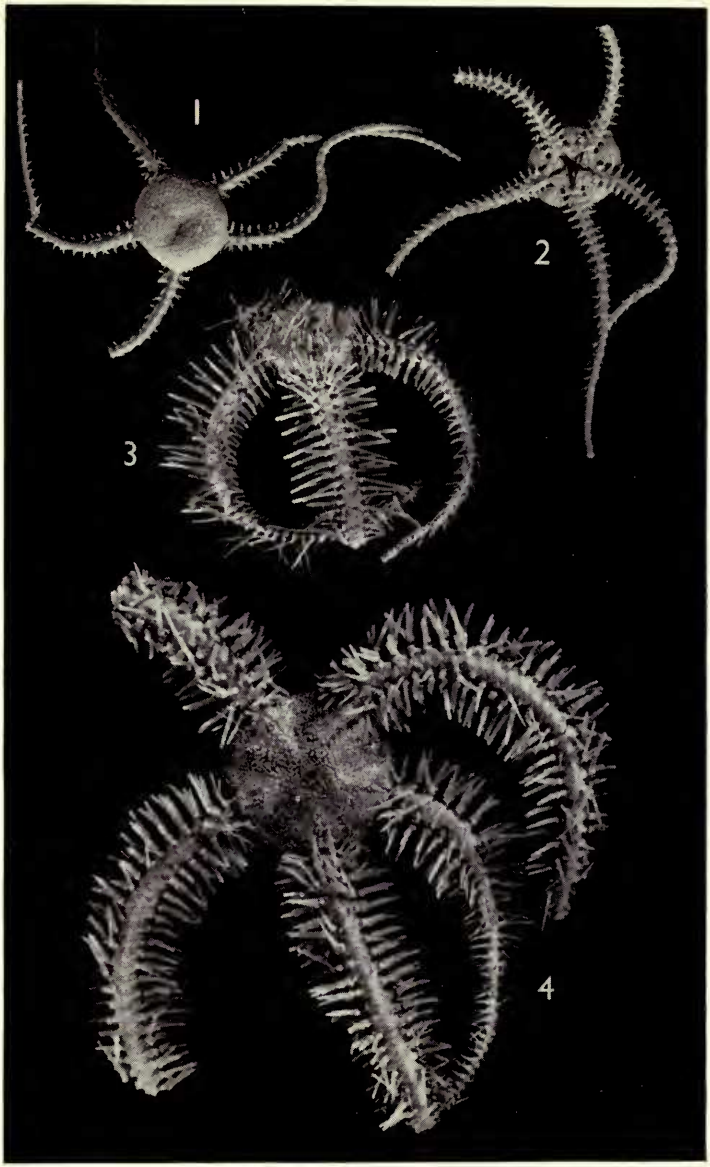
## PLATE 1

FIGS. 1, 2. *Ophioconis forbesi* (Heller). B.M. reg. no. 94.11.19.2, from La Ciotat, S. of France. ×3.

FIGS. 3, 4. Two syntypes of *Ophiothrix koreana* Duncan, B.M. reg. no. 80.1.3.13, from the Korean Straits, 42 metres, both ×3.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